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Karl R. Schrader
Lieutenant Colonel, United States Air Force

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*JOINT FORCES STAFF COLLEGE*

**JOINT ADVANCED WARFIGHTING SCHOOL**

# APPLYING LESSONS LEARNED FROM INTERWAR AIRPOWER (1919-1939) TO JOINT WARFIGHTING WITH CYBERPOWER

**by**

**Karl R. Schrader**

***Lieutenant Colonel, United States Air Force***

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**Karl R. Schrader**

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

Signature: _____

**Karl R. Schrader, Lt Col, USAF**

**6 April 2014**

**Thesis Adviser:** Signature: _____

**Gregory Miller, Ph.D.**
**Associate Professor, JAWS**
**Thesis Advisor**

**Approved by:** Signature: _____

**Bryon E. Greenwald, Ph.D.**
**Professor, JAWS**
**Committee Member**

Signature: _____

**S. Mike Pavelec, Ph.D.**
**Associate Professor, JAWS**
**Committee Member**

Signature: _____

**Richard E. Wiersma, Colonel, US Army**
**Director, Joint Advanced Warfighting School**

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## ABSTRACT

The United States has yet to use cyberwarfare in a major conflict, and the military services have differing ideas on what role cyberwarfare will play in America's next war. In addition, the services have unique and often contradictory perspectives on how they see the employment of cyberwarfare in military operations, and this conflict may affect combatant commanders' ability to employ cyberpower in their areas of responsibility.

The United States military faced a similar problem after World War I when attempting to understand and exploit the nascent capabilities of airpower, which showed great potential but exited the Great War with an inconclusive service record. The Interwar Period saw rapid advancement in aviation, and the U.S. military struggled with questions of how best to organize, equip, and employ airpower after World War I's inconclusive results. The differing approaches of the United States Army and the United States Navy toward airpower evolution during the Interwar Period yield several lessons in the areas of doctrinal, personnel, and technological development that are applicable to the future employment of Joint cyberpower in the post-Afghanistan War era.

This paper first explores how the culture and biases of the Army, Army Air Corps and Navy influenced the development of Interwar airpower theory and doctrine. It then examines airpower development through the lens of personnel, and uses the concepts of the change agent and the heterogeneous engineer to show how airpower development depended on the expertise and political acumen of senior officers who believed in airpower's potential and were determined to make it a reality. Finally, it looks at how the Army Air Corps and the Navy managed uncertainty about the nature of the nation's next war while in an environment marked by rapid technological progress in aviation.

## DEDICATION

To my wife and children, whose continuous support and understanding have been priceless as I write yet another thesis.

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# CHAPTER 1: INTRODUCTION

In February 2013, on his last day in office, outgoing Secretary of Defense Leon Panetta announced the creation of the Distinguished Warfare Medal, which recognizes, "extraordinary achievement, not including acts of valor, directly impacting combat operations" through "hands-on employment of a weapons system, including remote employment, or other activities in any domain."[1] The accompanying press release notes the medal "recognizes the changing face of warfare," and gives an example of awarding the medal to "a soldier at Fort Meade, Md., who detects and thwarts a cyberattack on a DoD computer system."[2] The announcement immediately sparked controversy, with veterans groups and members of Congress decrying the medal, whose order of precedence is higher than the Purple Heart and Bronze Star, as placing the achievements of military members thousands of miles away from a combat zone above those engaged in direct combat.[3] Responding to the criticism, Panetta's replacement, Secretary of Defense Chuck Hagel announced in April 2013 he was rescinding the medal and replacing it with a new device that services can add to existing medals.[4]

This controversy over whether or not cyberwarfare should be considered "real" combat and how cyber's contributions compare to those in the traditional three domains are indicative of the larger question of how the Army, Navy, and Air Force will organize, train, and equip cyber forces, and what roles and missions the services envision for

[1] Leon Pantta, Secretary of Defense, "Distinguished Warfare Medal," 13 February 2013, www.defense.gov/news/distinguishedwarfaremedalmemo.pdf.

[2] Jim Garamone, "Panetta Announces Distinguished Warfare Medal," http://www.defense.gov/news/newsarticle.aspx?id=119290.

[3] Leo Shane III, "Distinguished Warfare Medal is Off to a Rocky Start," http://www.stripes.com/distinguished-warfare-medal-is-off-to-a-rocky-start-1.210188.

[4] Jim Garamone, "Hagel Replaces Distinguished Warfare Medal with New Device," http://www.defense.gov/News/NewsArticle.aspx?ID=119778.

cyberpower in future conflicts. Cyberpower, defined as, "The ability to use cyberspace to create advantages and influence events in all the other operational environments and across the instruments of power,"[5] has yet to be used in a major conflict, and the military services and outside cyber experts have differing ideas on what role cyberpower will play in America's next war. In addition, the services have unique and often contradictory perspectives on how they see the employment of cyberpower in future military operations, and this conflict may affect combatant commanders' ability to employ cyberpower in their areas of responsibility.

While these challenges may seem unique, the United States military faced a similar problem after World War I when attempting to understand and exploit the nascent capabilities of airpower, which showed great potential but exited the Great War with an inconclusive service record. The postwar Army saw its air arm as one of many branches of the service, comparable to the signal corps, artillery, or engineers, whose purpose was supporting the infantry and the ground campaign. The Army Air Service, which became the Army Air Corps in 1926, had vastly different ideas on the role of airpower, and focused its efforts on gaining independence from the ground army, developing a wholly new concept of warfighting—strategic bombing—and pursuing the technology necessary to bring strategic bombing to life, in the form of the long range heavy bomber.[6] The Navy, unlike the ground Army, embraced the potential of airpower, working over two decades to develop the aircraft carrier and integrate it into the battle fleet, setting the stage for airpower to supplant naval gunfire as the main striking arm of the Navy.

[5] Franklin D. Kramer, Stuart H. Starr, and Larry K. Wentz, eds., *Cyberpower and National Security* (Washington D.C.: National Defense University Press, 2009), xvi.

[6] Wesley Frank Craven and James Lea Cate, *The Army Air Forces in World War II, vol. 1* (Chicago, IL: University of Chicago Press, 1955), 17.

An examination of the differing approaches of the United States Army and the United States Navy toward the evolution of airpower during the Interwar Period yields several lessons in the areas of doctrinal, personnel, and technological development that are applicable to the future employment of Joint cyberpower in the post-Afghanistan War era. Ultimately, a better understanding of how the services view where cyberpower capabilities fit into their roles and missions will provide the combatant commands with a better understanding of how to command, control, and employ effectively service cyber forces in future conflicts.[7]

Chapter 2 explores how the development of an innovation such as Interwar airpower is influenced by the culture and biases of the organizations, in this case the Army and Navy, which sponsor the innovation. Chapter 3 examines the development of airpower during the Interwar Period through the lens of personnel, and uses the concepts of the change agent and the heterogeneous engineer to show how airpower development depended in large part on the expertise and political acumen of senior officers who believed in airpower's potential and were determined to make it a reality. Chapter 4 looks at how the Army Air Corps and the Navy managed uncertainty about the nature of the nation's next war while in an environment marked by rapid technological progress in aviation. Finally, Chapter 5 provides lessons learned from the airpower historical case study, applies those lessons to cyberpower today, and discusses the implications of these findings for the organization, roles and missions of cyber forces in future conflicts.

[7] While other works have referenced the simiarities between Interwar airpower and modern cyberpower, none have performed an in depth analysis of Interwar airpower using these three lenses to glean lessons learned for the future of service-based cyberwarfare capabilites. See, for example, Robert M. Lee, "The Interim Years of Cyberspace," *Air & Space Power Journal* 27, no. 1 (2013): 58-79 (accessed October 29, 2013), and Bradley D. Converse, "Cyber Power and Operational Art: A Comparative Analysis with Air Power" (accessed January 28, 2014).

## CHAPTER 2: INTERWAR EVOLUTION OF SERVICE AIRPOWER THOUGHT

"The air force has ceased to remain a mere auxiliary service for the purpose of assisting an army or navy in the execution of a task."[1]

- General William Mitchell

"Both in offense and defense the fleet and naval aviation are one and inseparable."[2]

- Admiral William Moffett

How do military organizations develop doctrine for new technologies and incorporate them into their existing warfighting paradigms? During the Interwar Period, the Army and Navy struggled with the problem of how to manage the uncertainty created by a new dimension of warfare, airpower, while maintaining intraservice and interservice balances of political power. An analysis of the evolution of airpower thought in the Army, Army Air Corps, and Navy during this period shows that the services, while required to work together in wartime, tended in peacetime to employ airpower in accordance with their unique service cultures and service-specific theories of warfare.

### Background

In his work, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars,* Barry R. Posen uses organizational theory to explain how military organizations develop new doctrines and integrate new technologies into existing warfare concepts. Posen offers three general tendencies that explain how the hierarchical organization of military institutions affects their ability to incorporate, or resist,

[1] William Mitchell, *Winged Defense: The Development and Possibilities of Modern Airpower—Economic and Military* (Tuscaloosa, AL: University of Alabama Press, 2009), 8.

[2] Edward Arpee, *From Frigates to Flat-Tops; the Story of the Life and Achievements of Rear Admiral William Adger Moffett, U.S.N., "The Father of Naval Aviation," October 31, 1869-April 4, 1933* (Lake Forest, IL, 1953), 98.

innovation and new doctrine. Viewing the development of airpower through Posen's lens explains key Army Air Corps and Navy actions of the period, such as the Air Corps' near-obsession with strategic bombing doctrine, the stiff opposition of Army and Navy non-aviators to the development of airpower's offensive capabilities, and the conflict between the Air Corps and Navy over the organization and role of airpower in the U.S. military.

First, Posen argues, "that military organizations would probably prefer offensive doctrines because such doctrines reduce uncertainty and increase organizational size, wealth, and autonomy."[3] Offensive doctrines, defined as doctrines that "aim to disarm an adversary—to destroy his armed forces," allow military institutions to control the time and place of military engagement, and thus enable them to develop standard planning scenarios for each type of war they may expect to wage.[4] While allowing institutions to wage their preferred form of warfare, offensive doctrines at the same time enable them to deny a potential enemy his ideal form of warfare. Finally, offensive doctrines are manpower- and materiel-intensive, and require large standing bureaucracies to maintain control over the organization, ensuring the stability and survival of the institution.

The United States, in particular, defaults to offensive doctrines due to its advantage in military power over almost any adversary and its geographic security. Russell Weigley, in his work *The American Way of War*, notes that as the military power of the United States grew in the nineteenth century, it tended to fight wars of Clausewitz'

[3] Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Ithaca, NY: Cornell University Press, 1984), 223. While Posen goes on to state that the competing balance of power theory has slightly more overall explanatory power for describing doctrine development, he caveats this by noting, "In times of relative international calm, when statesmen and soldiers perceive the probability of war as remote, the organizational dynamics outlined above tend to dominate." Ibid., 59.

[4] Ibid., 14.

first type, those that sought the overthrow of the enemy, rather than the second type that seek more limited aims, usually the conquest of the enemy's frontiers.[5] America's offensive doctrine-oriented wars, including the Indian campaigns of the late 1800s and the Civil War, "suggested that the complete overthrow of the enemy, the destruction of his military power, is the object of war."[6] America's geography, unique for a major power with twin oceans protecting it from other major military powers, ensured its safety through the mid-twentieth century. From World War I on, the United States sought to preserve this advantage and protect its homeland by preferring offensive military doctrines that took the fight to the enemy's shores, rather than awaiting invasion.

Second, Posen states, "military organizations will seldom innovate autonomously, particularly in matters of doctrine. This should be true because organizations abhor uncertainty, and changes in traditional patterns always involve uncertainty."[7] Military organizations are very hierarchical, with strict rules for promotions and information flow, and they inherently restrict new ideas and innovative concepts from flowing freely from lower to higher echelons.[8] In addition, general and flag officers at the top of these organizations, being at the end of their careers, generally are resistant to new concepts or forms of warfare, as their positions show their mastery of existing doctrine and their skills would be rendered obsolete if new doctrines were to take hold in the institution.

Finally, Posen argues that, "organizational factors work against integrated grand strategies."[9] Since military institutions are primarily concerned with their own survival

[5] Russell F. Weigley, *The American Way of War: A History of United States Military Strategy and Policy* (New York: Macmillan Publishing Company, 1973), xx.
[6] Ibid., xxi.
[7] Barry R. Posen, *The Sources of Military Doctrine*, 224.
[8] Ibid.
[9] Ibid., 226.

and power relative to other military institutions, they have little incentive to work together to create common doctrine. A change to military doctrine inevitably creates winners and losers among military institutions—some organizations will see their budgets and prominence in the defense establishment increase, and others will become less relevant. This uncertainty about whether a new military doctrine will increase or decrease institutional power is enough for military organizations to not cooperate and instead work to preserve the status quo.

Carl Builder, in his work *The Masks of War: American Military Styles in Strategy and Analysis*, examines a different aspect of military organizations, their personalities, and argues these institutional personalities govern organizational behavior in developing doctrine, plans, weapons, and personnel. He posits that, "To understand the military institutions then—who they are and what they are about—is to understand almost everything of enduring significance in the national debates over military issues."[10] These institutional personalities help explain the attitudes of the Interwar Air Corps, Army and Navy toward the rise of airpower, and their actions to advocate for or resist its development.

Builder goes on to describe the culture of each service and their attitudes toward warfighting and technology. The Air Force sees itself as "the embodiment of an idea, a concept of warfare, a strategy made possible and sustained by modern technology."[11] The Air Force, like the Air Corps before it, believes an independent air force, free from the restrictions of the land and sea, and enabled by high technology, can achieve decisive effects against any enemy, anywhere in the world. The Army sees itself as a brotherhood

[10] Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis* (Baltimore, MD: Johns Hopkins University Press, 1989), 4.

[11] Ibid., 32.

of combat branches, including infantry, artillery, and engineers, which are all mutually supporting and interdependent.[12] The Army also values the quality of its soldiers over the weapons they use, and sees technology as a means to an end—increasing the soldier's effectiveness. The Navy's personality is steeped in love of tradition, and looks to tradition to protect itself when faced with a changing environment.[13] The Navy cherishes its independence and stature as the nation's sea power, and sees this as the most flexible kind of military power America can wield as an inherently maritime nation.

## The Army

The Army Air Service emerged from World War I with a mixed combat record. According to Major General Mason Patrick, Chief of Air Service, "the flying personnel trained in the Air Service schools was [sic] second to none in the world for aggressiveness and skill."[14] From the first Air Service combat units arriving in Europe in April 1918 until the end of the war, American pilots claimed 704 enemy airplanes and 72 balloons destroyed, while losing only 289 aircraft, resulting in a kill to loss ratio of almost two-and-a-half to one.[15] However, the Air Service's contribution to the war was inconclusive, in that the war ended before America and the Air Service reached their full aircraft manufacturing and combat potentials, respectively. This lingering uncertainty about the effectiveness of airpower in the years after World War I exacerbated the subsequent fight over what role airpower should play in the postwar Army.

[12] Ibid., 27.
[13] Ibid., 18.
[14] Mason M. Patrick, *The United States in the Air* (Garden City, New York: Doubleday, Doran and Company, 1928), 49.
[15] War Department, Office of the Director of the Air Service, "Brief History of the Air Service, American Expeditionary Forces," 1 July 1920, 12.

After World War I, airpower advocates in the Air Service and members of the traditional Army branches, embodied in the War Department's General Staff, had two very different ideas on who should control airpower, and how the Army should employ airpower in future wars. Interestingly, the primary battle between the General Staff and airpower advocates was not over how airpower should be used on the battlefield, but over who would control the air arm. In effect, the Army chose to tackle the problem of organization and control before that of employment and purpose.[16] Seen through the lens of Posen's organizational doctrine, this makes sense in that the addition of the personnel and resources of the air arm would mean greater power and influence for whichever of the two factions in the Army could control them.

Airpower advocates within the Air Service fought for autonomy, and later, independence, of the Army's air arm in the belief that airpower was fundamentally different from the other branches within the Army, and thus should be treated differently. Though the disastrous Mexican Expedition of 1916-1917 was the U.S. Army's sole use of airpower prior its involvement in World War I, airpower advocates nevertheless believed the Great War proved military aviation, "no longer was a mere auxiliary of other forces, but an important striking arm in itself."[17] Some advocates such as General Billy Mitchell believed that airpower, if developed properly and led by airminded officers, could achieve war-winning decisive effects on its own, without the need for an Army or Navy. Airpower advocates also believed that the airplane was "genus, not species, a new and unique instrument of destruction" that should not be limited to supporting the other

[16] Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917-1941* (Washington, D.C.: Office of Air Force History, U.S. Air Force, 1985), 20.

[17] R. Earl McClendon, *Autonomy of the Air Arm* (Washington, D.C.: Air Force History and Museums Program, 1954), 52.

branches of the Army.[18] Thus, to achieve airpower's full potential, advocates argued that the United States should ensure its air force is led by and controlled by airmen, and, more importantly, given a separate budget to ensure it has the technology and personnel to accomplish its mission.[19]

While the airpower Army believed the future of airpower lay in independent operations against the enemy's air forces and strategic targets, the General Staff saw the airplane as simply another weapon, comparable to the tank and field artillery piece, and that it would best be employed by Army ground commanders to achieve the land campaign's objectives.[20] The experiences of General John J. Pershing's American Expeditionary Force in World War I proved the effectiveness of existing Army doctrine—after all, America won the war—and the General Staff wanted to retain the AEF model of placing airpower under the control of ground commanders. Pershing himself echoed these views, stating that he did not believe airpower could win neither a war nor a battle by itself. The air force was an essential combat branch like the infantry or cavalry, and thus the air arm should remain in the Army under the control of ground commanders.[21] Ultimately, opponents of air autonomy within the General Staff and the War Department wanted to preserve the status quo and keep airpower subordinate to the Army, and thus sought to limit any increase in the power or prestige of the air arm.

For airpower advocates in the Interwar Army, the Air Corps Tactical School (ACTS), created in 1920 at Langley Field in Virginia, and relocated to Maxwell Field, Alabama, in 1931, served as the incubator for airpower doctrine in the Army. Unlike the

[18] Wesley Frank Craven and James Lea Cate, *The Army Air Forces in World War II, vol. 1* (Chicago, IL: University of Chicago Press, 1955), 19.
[19] Ibid.
[20] Ibid.
[21] Greer, *The Development of Air Doctrine in the Army Air Arm*, 23.

Navy and ground Army, who had centuries of history and tradition upon which to base their warfighting doctrines, the fledgling air force had only its experiences in World War I on which to base its organization, operations, traditions, and doctrine.[22] As such, the ACTS played a vital role as the source of much of the Air Corps' strategic thought and doctrine development, and served as keeper of the flame for an independent air force. The contributions of the ACTS during the Interwar Years can be divided into two periods, from 1920 to the creation of the Army Air Corps in 1926, and from 1926 to the start of World War II in 1939.

Major William C. Sherman, who in 1921 wrote a textbook on air tactics that the General Staff published in 1923 as Air Service Training Regulation 440-15, represents early ACTS strategic thinking.[23] Sherman divides Army aviation into two parts, the "air service" of observation and reconnaissance aircraft that served as an auxiliary to ground forces, and the "air force" of pursuit, bombardment, and attack aircraft that served as the air arm's striking power. The manual went on to describe the purpose of the air arm as gaining control of the air, then destroying enemy forces on the land and the sea. The Army released an update to 440-15 in January 1926, which expanded on the earlier version and granted "some concessions—but not much independence—to the Air Service."[24] In the updated version, the Army created a General Headquarters (GHQ), which served as a separate reserve unit for bombardment and pursuit aviation independent of corps and army commanders, with the purpose of providing mobile,

[22] Craven and Cate, *The Army Air Forces in World War II, vol. 1*, 34.

[23] Robert Frank Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force, 1907-1964* (Maxwell Air Force Base, AL: Aerospace Studies Institute, Air University, 1971), 23.

[24] Ibid., 28.

adaptable airpower to the entire front.[25] While the new 440-15 granted additional control of air assets to the aviators in command of GHQ, the regulation retained the traditional mission of aviation supporting the ground Army's efforts to destroy the enemy's fielded forces, with no provisions for strategic bombing operations.

After the creation of the Army Air Corps in 1926, spearheaded by General Mason Patrick, the Air Corps Tactical School began a transformation from an organization dedicated to espousing the General Staff view of airpower as a supporting branch for the ground infantry and the land campaign to one that served as the Army's "hub of airpower advocacy and indoctrination."[26] Billy Mitchell's theories on the effectiveness of airpower became ascendant, as many of his followers and protégés, including Robert Olds and Kenneth Walker, were assigned as key faculty members of the ACTS.[27] Also incorporating the writings of Italian airpower theorist Giulio Douhet, whose translated works appeared in America in 1933, these members of the "bomber mafia" developed the cornerstone of American airpower doctrine over the next decade—the concept of independent airpower using the high altitude heavy bomber and strategic bombing to destroy an enemy's war making ability.[28] The new doctrine espoused the need for concentrated action under the command of airmen and independent of the land campaign insofar as support of ground forces remained a necessary, but secondary, role for airpower.[29] Spearheaded by Walker, the ACTS then developed the Industrial Web theory of strategic bombing, which held that after conducting a thorough analysis of an enemy's

[25] Greer, *The Development of Air Doctrine in the Army Air Arm*, 41.

[26] David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army, 1917-1945* (Ithaca, NY: Cornell University Press, 1998), 155.

[27] Mark A. Clodfelter, "Molding Airpower Convictions: Development and Legacy of William Mitchell's Strategic Thought," in *The Paths of Heaven: The Evolution of Airpower Theory,* ed. Phillip Meilinger (Maxwell AFB, AL: Air University Press, 1997), 108.

[28] Greer, *The Development of Air Doctrine in the Army Air Arm*, 49.

[29] Ibid., 78.

industrial base, airmen could identify and destroy vital nodes of the enemy's system that would cause the system to collapse and destroy the enemy's ability to wage war.[30] Now that the Air Corps had a new worldview with supporting theories and doctrine, it needed a catalyst to turn ideas into reality. In 1934, an opportunity presented itself in the form of the Air Mail Fiasco.

From February to June 1934, President Franklin D. Roosevelt directed the Air Corps to fly the United States mail after cancelling the government's contracts with commercial carriers. The effort was a disaster, with the Air Corps crashing 66 aircraft and achieving an abysmal completion rate of 65 percent.[31] The resulting Baker Board formed by Congress to investigate the Fiasco recommended a reorganization of the dysfunctional Air Corps, and on March 1, 1935, the Army created a General Headquarters (GHQ) Air Force.[32] All air combat units, previously assigned to nine Army corps areas, were transferred to the control of GHQ Air Force and placed under the command of General Keith Andrews, an airman who reported directly to the Chief of Staff of the Army in peacetime and to the theater commander in wartime.[33] All training, acquisitions, and logistics remained under the control of the Chief of the Air Corps, who acted in a support role for the commander of GHQ Air Force. For the first time, all Army air combat assets were consolidated under one organization and commanded by an airman, finally putting into action the ACTS' vision for the employment of airpower. Army aviation underwent further unification in 1939, when the Army placed GHQ Air Force under the direct

[30] Johnson, *Fast Tanks and Heavy Bombers*, 162.

[31] John F. Shiner, "Benjamin D. Foulois: In the Beginning," in *Makers of the United States Air Force (USAF Warrior Studies)*, edited by John L. Frisbee (Washington, D.C.: Office of Air Force History, U.S. Air Force, 1987), 31.

[32] Craven and Cate, *The Army Air Forces in World War II, vol. 1*, 31.

[33] Greer, *The Development of Air Doctrine in the Army Air Arm*, 73.

command of the Chief of the Air Corps.[34] As an organization, the GHQ Air Force concept proved so successful that the Army Air Forces used it as the template for the Numbered Air Forces employed in Europe and the Pacific throughout World War II.[35]

By the end of the Interwar Period, the two-decade battle between airpower advocates and the General Staff over the function and organization of Army air forces was fought and won by the airmen. While the Army Air Corps remained a part of the United States Army, it had "a degree of separatism in thought and in action not to be found among the other arms and services under War Department control."[36] Through the efforts of the ACTS, the Air Corps entered World War II with a firm belief in the effectiveness of strategic bombing independent of the ground campaign, and the validity of the supporting Industrial Web doctrine. The creation of GHQ Air Force in 1935 gave control of combat airpower to an airman, who answered only to the theater commander and became the single voice for airpower in the theater.

## The Navy

Like the Army, the Interwar Navy was split over the role airpower would play in the next war. However, in the Navy's case, the differing opinions centered on how airpower could best support the Navy's role as the nation's guardian and master of the seas, rather than whether or not aviation should even remain in the Navy, as was the case in the Army versus the Air Corps. Over the two decades of the Interwar Period, the Navy's warfighting doctrine slowly evolved from the battleship-based battle line to a more flexible, integrated, surface and air striking force. Naval airpower advocates such as

[34] Futrell, *Ideas, Concepts, Doctrine*, 49.
[35] Maurer Maurer, *Aviation in the U.S. Army, 1919-1939* (Washington, D.C.: Office of Air Force History, 1987), 445.
[36] Craven and Cate, *The Army Air Forces in World War II, vol. 1*, 17.

Admiral William Moffett completed this transition by successfully integrating naval aviators into the line Navy, squelching calls by some airpower advocates for separation of Navy air from the line Navy and assuming a new status similar to the Marine Corps.

The evolution of naval aviation during the Interwar Period centered on the struggle between the old guard of the line Navy, who believed the power of the battleship would remain ascendant, and the airpower advocates, who believed that the airplane would someday supplant the battleship as the foundation of the fleet's striking power. The old guard, known as the "Gun Club" for their dominance of the Navy's Bureau of Ordnance, came of age in the turn-of-the-century Navy, where the dreadnought was "the undisputed champion of the seas" and Mahan's doctrine of the battle line reigned supreme.[37] In the years immediately following World War I, the Navy's General Board, dominated by members of the Gun Club, believed that the Navy would fight the next war much like the last, with the battleships of the main battle line fighting decisive actions against the enemy's battle line.[38] As members of the Navy's preeminent branch, the Gun Club naturally clashed with the new aviators, and resisted any expansion in the role of aviation in the Navy that might threaten the dominance of the battleship in the Navy hierarchy.[39] The battleship admirals were content to limit aviation's role in the fleet to that of reconnaissance and gunnery spotting, both of which significantly enhanced the accuracy and effectiveness of the dreadnought-based battle line.[40]

[37] Clark G. Reynolds, *The Fast Carriers: The Forging of an Air Navy* (Huntington, NY: Krieger Publishing Company, 1978), 1.

[38] Thomas Wildenberg, *Destined for Glory: Dive Bombing, Midway, and the Evolution of Carrier Airpower* (Annapolis, MD: Naval Institute Press, 1998), 21.

[39] Reynolds, *The Fast Carriers*, 16.

[40] Ibid., 17-18.

Airpower advocates within the Navy, on the other hand, were not initially unified, and generally fell into one of two groups. The first group consisted of the pioneers of naval aviation, who entered the Navy as pilots and were relatively junior in rank when aircraft carriers first entered the fleet in the late 1920s.[41] The other group was comprised of latecomers to naval aviation, mainly senior battleship officers respected by the line Navy who were recruited by Admiral Moffett to give naval aviation additional influence within the Navy hierarchy. Although the two groups initially clashed over the methods by and speed with which aviation should be integrated into Navy doctrine, Moffett used his sheer force of will to unify old and young aviators behind his conviction that it "behooves the Navy as a whole and entirely to embrace aviation and become thoroughly acquainted with it, so that they can use it to its fullest extent."[42]

In the early 1920s, when naval aviation was limited to float planes launched from shore or the turrets of dreadnoughts, Navy aircraft were used solely for naval gunfire spotting and long-range reconnaissance as "the eyes of the fleet."[43] With the commissioning of the Navy's first aircraft carrier, the USS *Langley*, in 1925, aviation's role expanded to air defense of the battle line, then to gaining air superiority over the fleet in order to protect friendly spotting aircraft while eliminating enemy spotting aircraft.[44] By the end of the 1920s, naval aviation doctrine evolved to include offensive operations against the enemy's fleet and shore targets. In 1927, the Navy conducted its first successful dive-bombing exercise against a moving target, which opened the way for carrier-based bombing to attack and disrupt enemy destroyers, whose mission was to

[41] Ibid., 16.
[42] Arpee, *From Frigates to Flat-Tops*, 115
[43] Reynolds, *The Fast Carriers*, 17.
[44] Wildenberg, *Destined for Glory*, 22, 24.

inflict enough damage on Navy battleships to slow down the battle line and impair its striking ability.[45]

Carrier air doctrine further evolved in the 1930s with technological advances in carrier aircraft speed, maneuverability, and firepower providing increased striking power for the fleet's aircraft carriers. From various fleet exercises and wargaming at the Naval War College, carrier commanders concluded that the best tactic for gaining air superiority was a preemptive attack on the enemy's aircraft in order to destroy them while they were still on the carrier's deck.[46] In the late 1930s, the role of the carrier expanded yet again to include attacking the enemy's battle line in order to damage his capital ships enough to slow down the enemy fleet, which the Navy's battle line would then engage and defeat.[47] By the end of the Interwar Period, the Navy reached a broad consensus that the aircraft carrier was now a partner to, rather than an auxiliary of, the battleship as the Navy's primary striking arm; that aircraft carriers could project combat power over great distances; and that the vulnerability of aircraft carriers to attack meant they should be targeted first to limit the enemy fleet's aerial striking ability.[48]

One of the main reasons why the Navy so effectively integrated airpower into its fleet doctrine was the successful integration of the naval aviator into the service's hierarchy and culture. Unlike the Army, where the Air Corps was a separate branch within the service, with its own unique, stovepiped organization, Moffett ensured naval aviators were line officers who served in both aviation and surface ship billets, eschewing

[45] Ibid., 54.
[46] Ibid., 126.
[47] Ibid., 158.
[48] Albert A. Nofi, "Aviation in the Interwar Fleet Maneuvers, 1919-1940," in *One Hundred Years of United States Navy Airpower*, ed. Douglas V. Smith (Annapolis, MD: Naval Institute Press, 2010), 123.

the "separate but equal" thinking of the Army.[49] The Navy, fortunately, had successful precedent for this integration, when during the turn of the century it had successfully integrated engineering officers into the line Navy in a similar fashion.[50] This integration was of vital importance when operating at sea, as unlike the Army, naval aviators had a symbiotic relationship with their surface ship brethren, with each depending on each other for transportation, support, and protection from other naval vessels.

By the end of the Interwar Period, the Navy completed an evolutionary change in doctrine from battleship surface fires to carrier aircraft air-to-air and air-to-surface fires as the primary offensive weapons of the battle fleet.[51] While airpower advocates in the Air Corps sought a revolutionary change in aerial warfare, from support of ground forces to waging an independent air campaign, the institutional culture of the Navy that espoused tradition above all led Navy airpower advocates working within the Navy to seek change in how the Navy executed its mission without changing the mission itself.

[49] Norman Polmar, *Aircraft Carriers: A Graphic History of Carrier Aviation and Its Influence on World Events* (Garden City, NY: Doubleday and Company, 1969), 43.

[50] Barry Watts and Williamson Murray, "Military Innovation in Peacetime," in *Military Innovation in the Interwar Period,* eds. Williamson Murray and Allan Millet (Cambridge, NY: Cambridge University Press, 1996), 396.

[51] Ibid., 384.

## CHAPTER 3: PERSONALITIES MATTER

"I am confident that no general thinks he can command the Navy, and no admiral thinks he can operate an army, but some of both believe they can operate an air force."
- Major Horace M. Hickam, 1926[1]

In *Airmen and Air Theory*, Philip Meilinger states, "All of us have a deep interest in knowing how others, perhaps like ourselves, have met challenges, dealt with failure, and accommodated themselves to victory and fame."[2] With this in mind, how do leaders of military organizations guide, influence, and protect the development and direction of technological innovation? An examination of the development of airpower during the Interwar Years through the lens of Army Air Service and the Bureau of Aeronautics leadership reveals the need for a cadre of high-ranking airpower converts with sufficient respectability, technological skill, political acumen, and legitimacy in order to advocate successfully for airpower within their services.

### Background

In his work, *Winning the Next War: Innovation and the Modern Military*, Stephen P. Rosen explores how militaries pursue innovation in peacetime and war, answering the question, "When and why do military organizations make major innovations in the way they fight?"[3] While explaining how militaries successfully innovate in peacetime, he outlines what types of leaders do or do not effectively innovate and why peacetime

[1] John F. Shiner, "Benjamin D. Foulois: In the Beginning," in *Makers of the United States Air Force (USAF Warrior Studies)*, ed. John L. Frisbee (Washington, D.C.: Office of Air Force History, U.S. Air Force, 1987), 22. Lieutenant Colonel Horace Hickam is the namesake of Hickam Air Force Base, Hawaii.

[2] Philip S. Meilinger, *Airmen and Air Theory: A Review of the Sources* (Maxwell AFB: Air University Press, 2001), 3.

[3] Stephen P. Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 1991), 1.

innovation inherently takes longer than wartime innovation. Viewing airpower advocates within the Army and Navy during the Interwar period through Rosen's lens of peacetime innovation aids in understanding how some innovators, such as Admiral William Moffett and General Mason Patrick, succeeded, while others such as General William "Billy" Mitchell did not.

Rosen argues that a combination of junior and senior officers, committed to changing the status quo while adhering to the rules and regulations of the current military bureaucratic system, is necessary in order for peacetime military innovation to succeed. Initially, senior military officers examine the current security environment, discover that structural changes have occurred, and conclude that the military organization requires a change or need for innovation.[4] These senior officers must then "attract officers with solid traditional credentials to the innovation," because senior-ranking converts are key to successfully navigating the bureaucratic establishment, thereby protecting the innovation from termination by the "old guard" who may resist the change to the status quo.[5] These senior officer advocates, in turn, "make it possible for younger officers to rise to positions in command while pursuing the innovation," ensuring the younger officers, who are more technically proficient in the mechanics of the innovation, are free from bureaucratic interference to develop the technology.[6] By protecting and promoting these younger officers, the senior officer advocates develop the next generation of senior leaders who will complete the adoption of the innovation by the organization.

Because of the senior and junior officer development required to complete the implementation of an innovation, Rosen notes that successful adoption of innovation is a

[4] Ibid., 76.
[5] Ibid., 96.
[6] Ibid., 96.

generational process in peacetime, likely taking years to decades. Officer promotions in peacetime military organizations are generally slower than during wartime; therefore changing the culture of a military organization through the advancement of young officers is also slower. Major innovations, such as the incorporation of airpower or cyberpower, require a fundamental rethinking of how the services organize and fight wars, and "the process is only as fast at the rate at which young officers rise to the top."[7]

In addition to senior officer change agents, successful innovation requires what John Law calls "heterogeneous engineers."[8] Law uses the term "heterogeneous engineering" to describe how the implementation of an innovation is comprised of a network of natural, social, and technical phenomena, all working in concert to describe and implement a technological change. For example, in examining the development of carrier aviation during the Interwar Period, fully understanding the nature of this innovation requires examining natural elements (characteristics of aerodynamics and hydrodynamics), technical elements (the design and construction of aircraft carriers and their aircraft), and social elements (carrier employment doctrine and political battles between aircraft carrier and battleship advocates).

Law goes on to define heterogeneous engineers as people who, "seek to associate entities that range from people, through skills, to artifacts and natural phenomena" in order to guide the development of new technologies.[9] Heterogeneous engineers use their advanced understanding of the natural environment, combined with a creative analysis of the potential of a new technology, to create new doctrines and tactics for implementation

[7] Ibid., 105.

[8] John Law, "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, eds. W.E. Bijker, T.P. Hughes, and T.J. Pinch (Cambridge, MA: MIT Press, 1987), 107.

[9] Ibid., 129.

of the innovation and integrate it into the existing organizational structure, building a new system that is greater than the sum of its parts. Heterogeneous engineers work symbiotically with change agents, with the engineers providing the change agents with concrete results of successful implementation of the innovation in order to bolster the agent's credibility, while the change agents create an innovation-friendly environment, protecting the engineers from interference by a potentially hostile bureaucracy.

## The Change Agent: Admiral William Moffett

Rear Admiral William A. Moffett served as the Navy's Chief of the Bureau of Aeronautics from its inception in 1921, until Moffett's death in 1933. A distinguished war hero and battleship captain, Moffett converted to aviation and became one of the fathers of U.S. naval aviation. He was a skilled political infighter, and succeeded in establishing the Bureau of Aeronautics to give aviators opportunities for promotion and command. He also fought against a separate Navy organization for aviation like the Army Air Corps and the Marine Corps, for he believed airpower should become an integral part of the fleet, not an adjunct or auxiliary to naval gunfire.

Graduating from the Naval Academy in 1890, Moffett began his career on Navy cruisers, winning the Medal of Honor in 1914 for his actions at the Battle of Veracruz, Mexico. He went on to command the Great Lakes Training Center and the superdreadnought USS *Mississippi* during World War I. In March 1921, the Navy named then-Captain Moffett as Director of Naval Aviation, a relatively toothless position at the time, as the Navy Department spread the responsibilities for aviation across almost a dozen different directorates and bureaus, with the Director having authority over none of them. As the new Director, Moffett joined the debate in Congress over whether or not to

create a unified Bureau of Aeronautics (BuAer), which would have authority and responsibility for all naval aviation activities. Moffett rose to the challenge, astutely focusing on the popular themes of "economy and efficiency," and emphasizing that the creation of BuAer would be the best way to bring order to the chaos of post-war naval aviation.[10] On July 13 that same year, President Warren Harding signed an appropriations act into law creating BuAer, and a week later Harding nominated Moffett as the first chief of the Bureau.

The act creating BuAer gave Moffett, in his role as chief, several unique powers that allowed him to leverage his political skill with his credibility as a member of the Gun Club in pursuing his goals of transforming naval aviation. BuAer was unique among its contemporaries in the Navy Department in that Moffett had control of both personnel, namely naval aviators, and the technical functions of aircraft development and procurement, logistics, and basing. The act also made mandatory that officers commanding aviation units, with the exception of aircraft carriers and tenders, be aviators. To assist in filling these newly recategorized command positions, the act created a Naval Observers course, designed to train senior Navy officers as aviators without resorting to the time- and skill-intensive pilot training course.[11] Throughout his tenure as chief, Moffett took full advantage of these favorable changes as he battled overly enthusiastic airpower advocates within the Navy, senior members of the Gun Club resistant to the rise of aviation's fortunes in the Navy, and airpower advocates within the Army seeking a unified aviation force.

[10] William F. Trimble, *Admiral William A. Moffett: Architect of Naval Aviation* (Washington D.C.: Smithsonian Institution Press, 1994), 78.

[11] Norman Friedman, "U.S. Aircraft Carrier Evolution, 1911-1945," in *One Hundred Years of United States Navy Airpower*, ed. Douglas V. Smith (Annapolis, MD: Naval Institute Press, 2010), 158.

Moffett's first challenge as Chief of BuAer was to reign in overzealous airpower advocates within the Navy, namely junior officers who spent their entire careers in aviation and felt that the Navy should pursue independence much like the Army Air Service was agitating for independence from the ground Army. Moffett opposed any separation of aviation officers from the fleet because it would isolate naval aviators from officers of the line, creating division and conflict within the Navy's officer corps and ultimately preventing integration of aviation into the fleet.[12] To this end, Moffett implemented an operations and staff rotation system where aviators would divide their careers between operational tours and staff tours at the Bureau, thereby increasing the breadth of experience and increasing their chances at promotion to senior ranks. Moffett also fought for and won a change to the law in 1926 to require that commanders of all aircraft carriers, seaplane tenders, and naval air stations possess an aeronautical rating.[13] Through these policies and incentives, Moffett successfully co-opted the junior aviators into endorsing his vision for integrating naval aviation into the fleet, while ensuring the availability of senior officer commands for them in the future.

Moffett also had to contend with the Gun Club, comprised of, "the entrenched conservatives, mostly high-ranking officers desperately clinging to their turf and defending it against all usurpations, real or imagined."[14] Using his skills of persuasion and promises of senior aviation command, Moffett sought out a number of senior naval officers who, like himself, had credibility within the battleship and non-aviation communities and converted them into airpower believers. These latecomers to aviation,

[12] Trimble, *Admiral William A. Moffett*, 7.
[13] Clark G. Reynolds, *The Fast Carriers: The Forging of an Air Navy* (Huntington, NY: Krieger Publishing Company, 1978), 15.
[14] Trimble, *Admiral William A. Moffett*, 7.

including Joseph Reeves, Ernest King, and William Halsey, gave naval aviation an instant stable of air admirals, significantly increasing aviation's influence within the Navy Department.[15] Moffett's insistence on keeping aviation integrated with the fleet, combined with his credibility with the non-aviation establishment, enabled him to act as a bridge between aviation and the Gun Club, while simultaneously fighting against those within the Army who sought to unify Army and Navy aviation into a separate service.[16]

Admiral Moffett also had to deal with the Army's believers in airpower, led by General Billy Mitchell, who had a much different vision for airpower than Moffett. Mitchell and his supporters believed airpower brought with it a new form of warfare, that the Army and Navy were unable to comprehend airpower's potential, and the services were therefore unable to employ it properly.[17] Moffett, mindful of the disastrous turn of naval aviation within the Royal Navy when the Royal Naval Air Service folded into the Royal Air Force, disagreed with Mitchell's views, which were anathema to Moffett's belief that naval aviation was an integral part of the Navy, and thus needed to remain in the Navy.[18] Fortunately for the Navy, Moffett astutely recognized Mitchell's outspokenness and "almost hysterical crusade to unify Army and Navy air" would be Mitchell's undoing, and did his best to stay out of Mitchell's way.[19] When Mitchell finally overreached with accusations of virtual murder and treason against the Navy for the crash of the airship USS *Shenandoah* in 1925, resulting in his famous court martial,

[15] Reynolds, *The Fast Carriers*, 16.

[16] Thomas C. Hone, Norman Friedman, and Mark Mandeles, *American & British Aircraft Carrier Development 1919-1941* (Annapolis, MD: Naval Institute Press, 1999), 165.

[17] Trimble, *Admiral William A. Moffett*, 8.

[18] Barry Watts and Williamson Murray, "Military Innovation in Peacetime," in *Military Innovation in the Interwar Period,* eds. Williamson Murray and Allan Millet (Cambridge, NY: Cambridge University Press, 1996), 394.

[19] Reynolds, *The Fast Carriers*, 15.

Moffett used the subsequent presidential air policy board to advocate for and win a five-year, one thousand-airplane construction program for BuAer.[20]

During his four terms as chief of the Bureau of Aeronautics, Admiral William Moffett exemplified Rosen's senior officer change agent. Moffett used the power of his office and his personal political skill to build a core group of airminded senior officers, setting the stage for naval aviation to assume preeminence within the Navy. In the words of naval aviator Lieutenant Commander Robert E. Byrd, with Moffett at the helm, "Flying stock went up in the Navy Department. With an Admiral to fight our battles we began to get things done….Best of all we had a well informed group of properly accredited officers to present our case to Congress when aviation matters came up."[21]

## The Change Agent: General Mason Patrick

General Mason Patrick served as head of the Army Air Service twice, from 1918 during World War I to 1919, and again from 1921 to 1927 as the Army Air Service struggled to define its role in the Army. Throughout his second term as head of the Air Service, Patrick advocated for a more independent role for the air arm, using his political skill, connections with senior Army leadership, and credibility as both an engineer and an aviator to push the War Department and Congress for more autonomy over aviation matters. His efforts culminated in the passing of the Air Corps Act of 1926, whose reforms marked the beginning of the air arm's process of gaining independence from the U.S. Army and led to the eventual creation of the United States Air Force in 1947.

[20] Trimble, *Admiral William A. Moffett*, 177.

[21] Edward Arpee, *From Frigates to Flat-Tops; the Story of the Life and Achievements of Rear Admiral William Adger Moffett, U.S.N., "The Father of Naval Aviation," October 31, 1869-April 4, 1933* (Lake Forest, IL, 1953), 86-87.

General Patrick took command of the Air Service with a vision for the near-term future of aviation and the credibility to implement it. Unlike Billy Mitchell's dreams of independence, Patrick believed airpower had not reached sufficient maturity in either technology or doctrine to justify a separate air force. Until airpower matured, Patrick focused his efforts on gaining autonomy for the air arm while remaining within the War Department; much like the Marine Corps enjoyed an autonomous status within the Navy Department.[22] Patrick wanted autonomy, not independence, and he knew this concept would be a much easier sell to the General Staff than that of an independent air force.

Assisting Patrick in his quest for autonomy was his credibility with both the General Staff and the aviation community and his sterling reputation as a bureaucratic troubleshooter. An engineer by trade, General John J. Pershing hired Patrick in October 1917 to command the Services of Supply when the previous commander was unable to tame the American Expeditionary Force's (AEF) logistics bureaucracy. After successfully reforming the SOS's organization, Pershing charged Patrick in February 1918 with reorganizing the AEF's headquarters, which was bloated, inefficient, and unresponsive to Pershing's needs.[23] Patrick succeeded there as well, and Pershing moved him in May 1918 to take over as Chief of Air Service, where Patrick again distinguished himself in reorganizing the Air Service into an effective fighting organization. Patrick's successes during the War, the fact that he was not a pilot, and Pershing's confidence in his abilities gave Patrick significant credibility with the General Staff, of which he would later take advantage when pushing for aviation reforms within the War Department.

[22] Robert P. White, *Mason Patrick and the Fight for Air Service Independence* (Washington D.C.: Smithsonian Institution Press, 2001), 6.

[23] Ibid., 18.

To implement his vision for Air Service autonomy, Patrick pursued several parallel lines of effort in the areas of organization, funding, and controlling Billy Mitchell. Throughout his tenure as Director, Patrick pushed for a fundamental reorganization of the Air Service, effectively dividing Army aviation into two categories. The Army's observation aviation, referred to as the "air service" and used for reconnaissance and artillery spotting, would remain assigned directly to ground units, and under the direct control of ground commanders. A separate Air Service organization, reporting directly to the War Department, would command the remainder of the Army's pursuit, bomber, and attack aircraft, referred to as the "air force".[24] Patrick scored a significant victory for this new concept in March 1923 when the Lassiter Board, convened by Secretary of War John Weeks to review this proposed reorganization and comprised of members of the General Staff, endorsed Patrick's proposals. [25] The board, in addition to recommending the creation of a General Headquarters Reserve that would activate in wartime to control army pursuit and bombardment forces for independent operations against the enemy, also recommended a ten-year, $150 million aircraft procurement program for the Air Service.[26] While Patrick pursued his agenda, he worked hard to keep Mitchell out of conflict with the General Staff, sending him on fact-finding missions to Europe in 1922, placing him out of the country during the Washington Naval Conference, and to the Pacific in 1924, after Mitchell stoked the Navy's anger by proving

[24] Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917-1941* (Washington, D.C.: Office of Air Force History, U.S. Air Force, 1985), 26.

[25] R. Earl McClendon, *Autonomy of the Air Arm* (Washington, D.C.: Air Force History and Museums Program, 1954), 63.

[26] White, *Mason Patrick and the Fight for Air Service Independence*, 79.

the effectiveness of aerial bombing in sinking several obsolete battleships in bombing experiments.[27]

For the remainder of his tenure as Director, Patrick focused his efforts on securing Congressional approval for the Lassiter Board's recommendations. In 1925, Congress and President Calvin Coolidge each convened boards to study the results of the Lassiter Board and make recommendations on the best way to organize military aviation for the nation's defense. Congress' board, the Lampert committee, recommended creating a Department of National Defense with a separate air force coequal with the Army and Navy. The Presidential board, the Morrow Board, reached the opposite conclusion, recommending more modest reforms that did not significantly change the status of the air arm.[28]

Patrick took advantage of these reports, and the accompanying renewed interest in aviation resulting from Billy Mitchell's court martial in 1925, to work with Congress and create a compromise piece of legislation granting limited autonomy to the Air Service while addressing War and Navy Department concerns over independence. The resulting compromise, the Air Corps Act of 1926, enacted several reforms and had several implications for the future of the air arm. The Act changed the Air Service's name to the Air Corps, established the office of the assistant secretary of war for aviation, added several aviation general officer billets, stipulated that all flying units be commanded by flying officers, reformed and streamlined the aircraft procurement process, and implemented a five-year Air Corps expansion program of 1,254 aircraft and over 6,600

[27] Mark A. Clodfelter, "Molding Airpower Convictions: Development and Legacy of William Mitchell's Strategic Thought," in *The Paths of Heaven: The Evolution of Airpower Theory,* ed. Phillip Meilinger (Maxwell AFB, AL: Air University Press, 1997), 92.

[28] Greer, *The Development of Air Doctrine in the Army Air Arm*, 29.

personnel.[29] Crucially, changing the Air Service's name to the Air Corps strengthened, "the conception of military aviation as an offensive, striking arm rather than an auxiliary service."[30] Hailed by Patrick as "a long step in the right direction," the Act ended the disruptive debate over aviation independence for the next eight years, until the Air Mail Fiasco in 1934 prompted another debate.[31] Patrick's efforts also increased aviation's representation in the general officer ranks and on the General Staff, in turn increasing the visibility of Air Corps interests within the War Department.[32] Finally, Patrick helped establish additional senior officer commands for pilots, ensuring for aviators the opportunity to rise to senior ranks and continue the fight for independence of the air arm.

### The Heterogeneous Engineer: Admiral Joseph Reeves

Admiral Joseph M. Reeves is an excellent example of heterogeneous engineering during the Interwar Period.[33] While Moffett's political acumen was vitally important in guiding and protecting the development of naval air power, in order to be successful, he needed the air navy to live up to his promises. Another former battleship commander, then-Captain Reeves' ingenuity, aviation knowledge, and credibility with both the Gun Club and the new generation of naval aviators enabled him to operationalize carrier aviation and place it on a sound footing going into World War II.

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[29] White, *Mason Patrick and the Fight for Air Service Independence*, 128-129.

[30] Greer, *The Development of Air Doctrine in the Army Air Arm*, 29.

[31] Robert Frank Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force, 1907-1964* (Maxwell Air Force Base, AL: Aerospace Studies Institute, Air University, 1971), 29.

[32] White, *Mason Patrick and the Fight for Air Service Independence*, 130.

[33] While Joseph Reeves is the best example of heterogeneous engineering in the period, the Army Air Corps also had a few successful heterogeneous engineers, namely Major General Benjamin Foulois. Foulois was one of the world's first writers on airpower theory, and focused his post-World War I career on developing the doctrinal, technological and organizational innovations he believed were needed for the United States to prevail in a future aerial conflict with Nazi Germany. However, Foulois' missteps during the Air Mail Fiasco ultimately limited his effectiveness in effecting change. See: Karl R. Schrader, "A Giant In the Shadows: Major General Benjamin Benjamin Foulois and the Rise of the Army Air Service in World War I," http://www.afhistoricalfoundation.org/images/awards/Schrader_SAASS_10.pdf.

Like Moffett, Reeves joined naval aviation late in his career. Reeves served most of his early career as an engineering officer, serving aboard the battleships USS *Oregon* and USS *New York* during the Spanish American War. After several tours as an ordnance officer, Reeves commanded the collier USS *Jupiter*, and then commanded the USS *Maine* and the USS *Kansas* during World War I, where he earned the Navy Cross. After the War, Reeves commanded several other ships of the line, and then became the head of the Tactics Department at the Naval War College in 1923. During his tour at the War College, Reeves concentrated his studies on the employment of the aircraft carrier (of which the United States had none at the time) against the capital ships of an enemy fleet, resulting in the development of the Navy's first aviation striking tactics.[34]

In June 1925, his old commanding officer from the USS *Oregon*, Admiral Edward W. Eberle, now the Chief of Naval Operations, selected Reeves as commander, Aircraft Squadrons, Battle Fleet. In accordance with the 1921 law requiring all aviation units in the Navy to be commanded by a naval aviator, Reeves volunteered for aviation duty at the age of 53, subsequently qualifying as a Naval Aviator Observer. In October, Reeves relocated to Mare Island, California, to join his new flagship, the USS *Langley*, which had been converted from the USS *Jupiter*—Reeves' old command—into the Navy's first aircraft carrier. After observing carrier operations onboard his flagship for six weeks, in November 1925, Reeves gathered all the officers in his command in the auditorium at the North Island air station and gave a history-making lecture on his observations and ideas on naval air power that would indelibly shape naval aviation to this day.

[34] Douglas V. Smith, "Admiral Joseph Mason "Bull" Reeves, Father of Navy Carrier Aviation," in *One Hundred Years of United States Navy Airpower,* ed. Douglas V. Smith (Annapolis, MD: Naval Institute Press, 2010), 83.

Against the backdrop of the Lassiter and Morrow boards, convened to determine the future of America's military aviation forces, and the ongoing court martial trial of Billy Mitchell, Reeves began his speech by outlining several dozen problems he saw in the unit's carrier operations, concluding that the officers had "no conception of either the capabilities or limitations of the air force."[35] Among his concerns were the fact that the *Langley* was underutilizing the large flight deck by operating only eight planes, the lack of coordination among the aircraft once airborne, and the excessive time required to launch and recover aircraft. Based on his wargaming experiences at the War College and his engineering experiences in the surface fleet, Reeves knew his units could operate more efficiently and effectively with the proper technology, experimentation, and innovation. Over the next year, Reeves pushed the limits of his people and equipment to turn the *Langley* from an experimental oddity into a part of the battle fleet.

As commander, Aircraft Squadrons, Reeves spearheaded multiple innovations in aircraft carrier operations, many of which are still in use today. One of Reeves' first innovations came in late 1925 with his development of the "deck park" method of recovering aircraft, in which aircraft would land using arresting wires and taxi forward to the fore of the ship. Deck hands then erected a barrier at mid-ship to catch the next aircraft should it miss the arresting wires. In 1926, he and his executive officer, Commander John Towers, revolutionized the organization and employment of aircraft carrier flight deck servicing operations. Reeves divided the flight deck crew responsible for launching, recovering, and servicing the aircraft into groups of specialists, with each group focusing on one aspect of flight deck operations. To deconflict the various groups'

[35] Thomas Wildenberg, *Destined for Glory: Dive Bombing, Midway, and the Evolution of Carrier Airpower* (Annapolis, MD: Naval Institute Press, 1998), 4-5.

operations on the loud and crowded flight deck, each specialist group wore different colored shirts, with blue for plane spotters, purple for fuelers, brown for crew chiefs, and yellow for flight directors, who ensured launch and recovery operations ran smoothly.[36] The deck park and colored shirt techniques enabled Reeves to decrease launch times to fifteen seconds per aircraft and recovery times to less than ninety seconds, ultimately allowing him to increase the *Langley's* aircraft complement from 14 to 48 aircraft.[37] The subsequent successes in reducing launch and recovery times under real-world conditions during the Navy's fleet problem exercises convinced the Navy of the validity of Reeves' innovations, and his tactics and techniques informed the design and construction of the Navy's next generation of aircraft carriers, the USS *Lexington* and USS *Saratoga*.[38]

Reeves' role as a heterogeneous engineer was instrumental in the development of the modern carrier concept.[39] During his command of Aviation Squadrons, Battle Fleet, Reeves combined the physical, technical, and social elements of the nascent concept of carrier operations and created the prototype for how all future aircraft carriers would operate in the Navy's battle fleet. Ultimately, Reeves took an experimental idea, projecting air power from a ship, and turned the aircraft carrier and its aircraft into an integral part of the battle fleet. Reeves' hard won successes with the USS *Langley* played a vital role in keeping naval aviation as a part of the Navy by providing hard evidence for use by Moffett and BuAer as they fought efforts, led by Billy Mitchell, to combine all aviation under a separate branch of the military.[40]

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[36] Ibid., 7.
[37] Watts and Murray, "Military Innovation In Peacetime," 402.
[38] Hone, Friedman, and Mandeles, *American & British Aircraft Carrier Development,* 45.
[39] Ibid., 151.
[40] Ibid., 185.

## CHAPTER 4: TECHNOLOGY AND UNCERTAINTY

"If it takes three months to train an artilleryman and ten months to build a cannon, then you have got to have a reserve of cannon. But when it takes a year to build an airplane and up to three years to train the crews to operate and maintain that airplane, then there is not quite such a big argument for a reserve of airplanes, particularly where aeronautical advancement in types is as rapid as it is today. We cannot afford to equip the air force of tomorrow with the airplanes of yesterday."[1]

- General Frank M. Andrews

How do military organizations manage uncertainty in an environment of rapid technological progress? During the Interwar Period, the Army Air Corps and the Navy took two different approaches to developing a research, development, and procurement strategy, yet the rapid technological progress of aviation during the Period led them both to pursue similar approaches in how they managed this technological uncertainty to meet their differing wartime requirements. Ultimately, the rapid advancement of aviation technology, combined with a fiscally constrained budgetary environment, led both services to rely on procuring low production lots of several generations of aircraft in order to keep their fleets up-to-date in preparation for the next war.

### Background

Stephen Rosen argues that a fundamental problem in managing military research and development and procurement programs is that uncertainty about the nature and capabilities of future enemies and the unknown costs and benefits of new technologies makes it difficult to identify what set of investments best meets the military's needs.[2]

[1] DeWitt S. Copp, "Frank M. Andrews: Marshall's Airman," in *Makers of the United States Air Force (USAF Warrior Studies)*, edited by John L. Frisbee (Washington, D.C.: Office of Air Force History, U.S. Air Force, 1987), 45.

[2] Stephen P. Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 1991), 243.

Rosen turns to economics to describe two main types of flexibility that military organizations can pursue in order to manage this uncertainty and ensure the organization is able to meet any future threat.

Organizations employing "Type I" flexibility tend to search for weapon systems or technologies that would be effective across a wide range of combat scenarios.[3] For example, the United States Navy's F/A-18 is able to perform a variety of missions, including offensive counterair, fleet defense, interdiction, and electronic warfare missions, depending on the carrier strike group's requirements. However, in times of great uncertainty, or when technology is advancing rapidly, purchasing Type I flexibility can be prohibitively expensive.

An alternative is "Type II" flexibility, which involves investing heavily in research, development, and testing to determine the military utility of different technologies.[4] The military organization then defers large-scale production of the hardware until the nature of the enemy and likely uses for the technology reveal themselves. While Type II flexibility is less expensive overall to implement than Type I flexibility, organizations that rely on Type II flexibility must be able to mass-produce combat equipment from prototypes on relatively short notice, lest the organization go to war with inadequate quantities of materiel.

Rosen also makes the counterintuitive argument that peacetime innovation can occur successfully even in times of constrained military budgets. Technological innovation is generally very expensive and resource intensive, so organizations should find it more difficult to innovate when less money is available for development.

[3] Ibid., 244.

[4] Ibid., 245.

However, Rosen makes a crucial distinction between initiating innovation and operationalizing it. While the latter is indeed very expensive, as evidenced by the U.S. military's expenditures on airpower during World War II, initiating an innovation and "bringing it to the point where it becomes a strategically useful option" can be accomplished with far fewer expenditures.[5] This distinction becomes even more important in periods of reduced budgets, such as the early years of the Great Depression.

## The Army

When determining what missions to prepare for and procuring the appropriate types of aircraft to execute those missions, the Army Air Corps faced two distinct challenges. First, the air arm needed to determine against what enemy it would fight in the next war. Second, for most of the period, the aviation technology available to the Air Corps was wholly inadequate to execute the warfighting doctrine being developed at the Air Corps Tactical School, specifically the Air Corps' need for a long range, heavy bomber to fulfil the promise of strategic bombing. Complicating these needs was the constrained budgetary environment throughout the 1920s and early 1930s that forced the Air Corps to choose between development of its favored strategic bombers and other mission types, including pursuit and attack aircraft. The period also saw several misfires, including the orphaning of pursuit and attack aircraft and the disastrous Air Mail Fiasco of 1934.

The Air Corps did not focus its Interwar efforts on preparing for a specific enemy, instead opting to center its doctrine and procurement on defending against a strategic bombing attack on the United States, mirror imaging its own offensive bombing doctrine.

[5] Ibid., 252.

With isolationism dominating United States strategic thought, the Air Corps knew it had to advocate for a homeland defense mission if airpower was to receive support and funding from Congress. Potential war against Canada or Mexico was unlikely, and while the rise of Japan was of concern, Air Corps planners realized the Navy would dominate any potential war with Japan, with the Air Corps relegated to defending American possessions in the Pacific such as the Philippines. To secure its legitimacy in the nation's defense, and a share of the ever-shrinking defense budget, the Air Corps sought to define a new threat—an undefined enemy attack on the American industrial heartland using long range bombers, to show how the Navy would be unable to defeat the threat, and to offer as an alternative long range strategic bombing on the enemy's heartland to counter the threat.[6] Thus, in the late 1930s the Air Corps advocated for airpower as the defender of the Western Hemisphere, ranging beyond the Army and Navy to strike the undefined enemy's warmaking capability (though Germany's military rearmament made it a prime contender), while denying him the ability to affect American warmaking ability.[7]

However, aircraft technology development in the 1920s and early 1930s, while rapid, could not keep up with the development of airpower thought at the Air Corps Tactical School. From the end of World War I to 1926, the vast, leftover stocks of Great War-era Liberty engines and aircraft such as the DH-4 stalled the Air Service's ability to develop new aircraft and powerplants.[8] Around the time the World War I stocks ran out, American aviation corporations began making great advancements in aviation

[6] Peter R. Faber, "Interwar US Army Aviation and the Air Corps Tactical School: Incubators of American Airpower," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Phillip Meilinger (Maxwell AFB, AL: Air University Press, 1997), 193.

[7] Ibid., 203.

[8] Robert Frank Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force, 1907-1964* (Maxwell Air Force Base, AL: Aerospace Studies Institute, Air University, 1971), 31.

technology, with all-metal airframes replacing the old wood frame and fabric, monoplanes supplanting biplanes, and aircraft incorporating drag-reducing innovations such as retractable landing gear and advanced engine cowlings.[9]

During the 1930s, the dearth of research and development and procurement funding resulting from the Great Depression forced the Air Corps to curtail its overall aircraft development program in order to fund fully one aircraft type. Given the ACTS' focus on strategic bombing, in December 1933, the Air Corps submitted its Project B proposal, which solicited a strategic bomber that could deliver a 2,000-pound bomb load over 2,200 miles at 250 miles per hour.[10] In August 1935, Boeing responded to the proposal with its Model 299, a four-engine, all-metal, long range monoplane bomber that the Air Corps accepted as the B-17. Finally, the strategic bombing advocates of the ACTS had an airplane that could realize their theories, or as General Henry "Hap" Arnold noted, "for the first time in history air power that you could put your hand on."[11]

The dominance of strategic bombing theory at the ACTS, combined with the constrained budgets associated with the Great Depression, completely overshadowed Air Corps development of attack and pursuit aviation. In the late 1920s, Captain George Kenney was the keeper of the flame of attack aviation thought at the ACTS, and during his tenure, the school made great strides in developing technologies and tactics for supporting ground troops.[12] However, after Kenny's departure from the ACTS in 1931, attack aviation thought stagnated in favor of strategic bombing. Attack aircraft

[9] Wesley Frank Craven and James Lea Cate, *The Army Air Forces in World War II, vol. 1* (Chicago, IL: University of Chicago Press, 1955), 58.

[10] Benjamin D. Foulois with C. V. Glines, *From the Wright Brothers to the Astronauts: The Memoirs of Major General Benjamin D. Foulois* (New York: McGraw Hill Book Company, 1968), 231.

[11] Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917-1941* (Washington, D.C.: Office of Air Force History, U.S. Air Force, 1985), 47.

[12] Geoffrey Perret, *Winged Victory: The Army Air Forces in World War II* (New York, NY: Random House, 1993), 26.

development slowed to a crawl during the 1930s, and would not resume until after America entered World War II.[13] After all, attack aviation's main purpose was to provide support to the ground Army, an activity that advocates for an independent air force based on strategic bombing saw as unproductive.[14]

Pursuit aircraft development likewise suffered during the 1930s. At the ACTS, Captain Claire Chennault, an instructor from 1931 to 1936 and pursuit aviation advocate, contended that pursuit aviation would be vital in a future aerial conflict, both to clear the skies of enemy fighters over the enemy's homeland for friendly bombers and to protect America from enemy long-range bombers.[15] However, the limited range and speed of pursuit aircraft during the 1930s, relative to the new generation of bombers, namely the B-17, led the bomber-dominated Air Corps to dismiss Chennault's arguments in the belief that pursuit aircraft would be able to do little more than harass American bombers at short range.[16] By the end of the 1930s, Air Corps thought crystallized around the assumption that unescorted bomber formations, employing high altitude precision daylight bombing techniques, "could fight their way through enemy skies without suffering prohibitive losses."[17] The Air Corps continued to hold onto this assumption through the early stages of the Combined Bombing Offensive of World War II, without adequately accounting for the fact that other nations were achieving rapid advancements in pursuit aircraft technology, resulting in near-disaster for the bomber forces.[18]

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[13] Greer, *The Development of Air Doctrine in the Army Air Arm*, 66-67.

[14] Perret, *Winged Victory*, 26.

[15] David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army, 1917-1945* (Ithaca, NY: Cornell University Press, 1998), 156-157.

[16] Ibid., 166.

[17] Williamson Murray, "Strategic Bombing: The British, American, and German Experiences," in *Military Innovation in the Interwar Period,* eds. Williamson Murray and Allan Millet (Cambridge, NY: Cambridge University Press, 1996), 125.

[18] Faber, "Interwar US Army Aviation," 220.

The Air Corps' singular devotion to high altitude precision daylight bombing also indirectly led to the Air Mail Fiasco of 1934. When asked to fly the mail by President Roosevelt, Chief of the Air Corps, General Benjamin Foulois committed his pilots knowing that very few of them had instrument and night-flying experience, that very few of his aircraft had radios and blind-flying instruments, and that both were necessary to fly the airmail routes during the winter.[19] Foulois' enthusiasm to take on the challenge and his faith in his pilots led to near-disaster and the loss of twelve pilots in three months. In the aftermath of the fiasco, the Secretary of War convened the Baker Board in 1934 to take a critical look at Air Corps operations and training and make recommendations on modernizing the Corps. The resulting report marked a seminal moment in the history of the Air Corps, and Foulois considered the report to be, "the first comprehensive outline of War Department policy with respect to aviation that the Army has ever had."[20] The report called for, and the Air Corps subsequently received from Congress, more flying hours for pilots, more ammunition and bombs for training, better navigation instruments, and resulted in the creation of the General Headquarters Air Force.[21]

## The Navy

During the Interwar Period, the Navy had a specific future conflict in mind when planning for the next war, and placed a heavy emphasis on developing technologies that could defeat the Japanese Navy in a Pacific naval campaign. Carrier aircraft development proceeded rapidly throughout the period, with a combination of Navy-owned and commercial aircraft development organizations working together to solve many Navy-

[19] Foulois, *From the Wright Brothers to the Astronauts*, 242.
[20] Maurer Maurer, *Aviation in the U.S. Army, 1919-1939* (Washington, D.C.: Office of Air Force History, 1987), 317.
[21] Ibid., 316.

specific technological hurdles. Aircraft carrier development was subject to the restrictions of the Washington Naval Treaty, and carrier designs changed in response to wargame and fleet exercise inputs. The Navy also pursued several technological dead ends, notably the rigid airship, which Admiral William Moffett advocated to augment the aircraft carrier.

After World War I, only two nations, Japan and Great Britain, posed a threat to the United States Navy on the seas. Navy planners of the 1920s such as Captain Harry Yarnell posited that both Japan and Great Britain depended on command of the seas to protect their overseas trade, and both would therefore build up navies sufficiently powerful to protect their sea lines of communication, which could also challenge America's command of the sea in a future conflict.[22] Because planners within the Planning Division of the Office of Naval Operations deemed conflict with Great Britain unlikely, the Navy's almost singular focus during the 1920s and 1930s was developing a naval force that could engage and defeat the Japanese fleet, then impose a sea blockade of the Japanese home islands.[23]

Navy thinking held that the Japanese fleet would refuse battle with the American Navy until the long journey to the western Pacific diminished its striking power.[24] Anticipating battle with the Japanese far from friendly shores, the Navy realized it would have to bring its own air support, necessitating the rapid development of both aircraft carriers and their airplanes.[25] This focus on defeating the Japanese battle fleet in the

[22] David R. Mets, "The Influence of Aviation on the Evolution of American Naval Thought," in *The Paths of Heaven: The Evolution of Airpower Theory,* ed. Phillip Meilinger (Maxwell AFB, AL: Air University Press, 1997), 123.

[23] George W. Baer, *One Hundred Years of Sea Power: The U.S. Navy, 1890-1990* (Stanford, CA: Stanford University Press, 1994), 90.

[24] Mets, "The Influence of Aviation on the Evolution of American Naval Thought," 126.

[25] Geoffrey Till, "Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies," in *Military Innovation in the Interwar Period,* eds. Williamson Murray and Allan Millet (Cambridge, NY: Cambridge University Press, 1996), 221.

central and western Pacific provided the Bureau of Aeronautics with both a guidestar for its technological development of carrier airpower, and a yardstick against which it could measure the U.S. Navy's progress.[26]

Naval aircraft development during the period evolved from a Navy-led design process with small lot buys during the 1920s to a commercial-led process with negotiated contracts in the 1930s, and yielded many important technological breakthroughs that placed naval aviation on a sound footing on the eve of World War II. From the inception of naval aviation through World War I, the Navy owned both research and development organizations and the Naval Aircraft Factory in Philadelphia, which competed with commercial aircraft companies for Navy aviation contracts.[27] When World War I aircraft production contracts expired, the commercial sector saw the Navy Factory as a threat to their operations, as there were no longer enough aircraft orders to keep all the companies in business. As a compromise, Admiral Moffett agreed to limit the Navy Factory to designing, testing, and building small lots of experimental aircraft, while awarding production contracts to the commercial aircraft manufacturers.[28]

By the end of the 1920s, aircraft design and innovation efforts shifted from the Bureau of Aeronautics' engineers to the aircraft manufacturers, allowing the Navy to pursue several aircraft design approaches with different companies simultaneously, resulting in a new wave of technological advancements for carrier aviation in the 1930s.[29]

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[26] Ibid., 203.

[27] William F. Trimble, *Admiral William A. Moffett: Architect of Naval Aviation* (Washington D.C.: Smithsonian Institution Press, 1994), 10.

[28] Ibid.

[29] Thomas Wildenberg, *Destined for Glory: Dive Bombing, Midway, and the Evolution of Carrier Airpower* (Annapolis, MD: Naval Institute Press, 1998), 152.

First, the evolution of the air-cooled engine was the most important advancement in naval aviation during the period. Air-cooled engines were lighter, more durable, and much more powerful than their water-cooled counterparts, and quickly gained worldwide popularity.[30] The early 1930s also saw the introduction of the cowl ring, which reduced the drag produced by an aircraft engine's exposed cylinders, and retractable landing gear, which drastically improved speed and maneuverability performance.[31] In 1935, the era of biplanes ended for the Navy with the introduction of the BT-1 dive bomber, the service's first all metal monoplane.[32] Later advancements included strengthened landing gear to accommodate carrier landings and folding wings to enable carriers to embark more aircraft.[33] Like the Air Corps, the Navy's strategy of small lot buys and close cooperation with civilian manufacturers resulted in rapid advancement of naval aircraft.

Naval aircraft carrier development during the period was much more dependent on outside factors, namely the Washington Naval Treaty, than carrier aviation. In 1921, President Warren Harding proposed a treaty between the United States, Great Britain, Japan, France, and Italy to prevent a new arms race in capital ship building after World War I. The 1922 treaty limited the United States to not more than 135,000 tons worth of aircraft carriers, and imposed a 27,000-ton limit on aircraft carriers, while also allowing two 33,000-ton carriers to be built on existing capital ship hulls. These limits imposed by the Washington Naval Treaty guided aircraft carrier development throughout the 1930s.

[30] Edward Arpee, *From Frigates to Flat-Tops; the Story of the Life and Achievements of Rear Admiral William Adger Moffett, U.S.N., "The Father of Naval Aviation," October 31, 1869-April 4, 1933* (Lake Forest, IL, 1953), 127.

[31] Wildenberg, *Destined for Glory*, 110.

[32] Ibid., 136.

[33] Ibid., 149.

After the commissioning of the USS *Langley*, the Navy converted two battle cruiser hulls into its first two purpose-built aircraft carriers, the USS *Saratoga* and USS *Lexington*, in November and December of 1927, respectively.[34] Both ships weighed in at 33,000 tons, and at 888-feet long were the largest ships in the Navy. Incorporating important lessons learned from Admiral Reeves' experiments with the USS *Langley*, both carriers had arrestor wire and barrier systems, allowing them to carry over 100 aircraft each.[35] The carriers also incorporated Reeves' deck park scheme, with both ships able to refuel and rearm aircraft on the flight deck.[36] The "Sara" and "Lex" formed the mainstay of the Navy's carrier fleet throughout the 1930s, and their participation in the Fleet Problems exercises led to the design and validation of many of the carrier tactics used in the early months of World War II. However, the combined 66,000 tons of the two carriers left the Navy with just 69,000 tons available for the rest of the carrier force, and the Navy had to make a tough choice on the size and number of future carriers.[37]

The limits imposed on the Navy by the Washington Naval Treaty and the enormous cost of the *Saratoga* and *Lexington* led the Bureau of Aeronautics to change course in carrier development, and the next generation reflected a new strategy of building smaller carriers in greater numbers, which would enable the fleet to put its airplanes in the air faster than a few larger carriers.[38] The USS *Ranger*, commissioned in June 1934, weighed in at a svelte 14,500 tons, and was 739 feet long. However, subsequent sea trials showed smaller carriers like the *Ranger* lacked the range, protection,

[34] Norman Polmar, *Aircraft Carriers: A Graphic History of Carrier Aviation and Its Influence on World Events* (Garden City, NY: Doubleday and Company, 1969), 53.

[35] David A. Hobbs, *A Century of Carrier Aviation: The Evolution of Ships and Shipborne Aircraft* (Annapolis, MD: Naval Institute Press, 2009), 108.

[36] Ibid., 140.

[37] Thomas C. Hone, Norman Friedman, and Mark Mandeles, *American & British Aircraft Carrier Development 1919-1941* (Annapolis, MD: Naval Institute Press, 1999), 55.

[38] Ibid., 57.

speed, and stability of larger warships, and would be of limited use in a war against Japan.[39] Realizing his mistake, BuAer quickly pivoted back toward larger carrier designs, and the next two carriers, USS *Yorktown* and USS *Enterprise*, were significantly larger than the *Ranger*. The carriers weighed in at 19,900 tons each, were 809 feet in length, and could carry over 80 aircraft each.[40] This forced experimentation with both large and small aircraft carriers helped the Navy determine the optimal size and configuration for fleet carriers in a future war with Japan, and contributed much to the design of the wartime *Essex*-class carrier that proved so successful in World War II.

Preparations for a future war with Japan also explain the rise and fall of Navy airship aviation in the 1920s and early 1930s, and provides a cautionary tale on embracing a technology even after it has been supplanted by new alternatives. Admiral Moffett and other airship enthusiasts saw the giant aircraft, with their endurance and payload advantages over early airplanes, as ideal for long-range reconnaissance in the vast stretches of the central and western Pacific.[41] However, technical and operational problems plagued the Navy's rigid airship program, and Moffett's desire to promote the airship's all-weather capability in order to secure additional funding led to many hazardous flights in foul weather.[42] After several high profile airship disasters, including the USS *Shenandoah* in 1925 (14 killed), the USS *Akron* in 1933 (73 killed, including Admiral Moffett), and the USS *Macon* in 1935 (2 killed), the Navy abandoned the rigid airship in favor of long-range float planes such as the PBY *Catalina*, introduced in 1936.

[39] Trimble, *Admiral William A. Moffett*, 15.
[40] Polmar, *Aircraft Carriers*, 71.
[41] Trimble, *Admiral William A. Moffett*, 125.
[42] Ibid., 14.

# CHAPTER 5: LESSONS LEARNED AND CONCLUSION

The Interwar Period saw rapid advancement in aviation, and the U.S. military struggled throughout the period with questions of how best to organize, equip, and employ airpower after World War I's inconclusive results in the effectiveness of airpower in warfare. The differing approaches of the United States Army and the United States Navy toward the evolution of airpower during the Interwar Period yield several lessons in the areas of doctrinal, personnel, and technological development that are applicable to the future employment of Joint cyberpower in the post-Afghanistan War era.

## Lesson Learned: Doctrine

*Lesson Learned: Though part of a Joint team, the military services will tend to employ cyberpower in accordance with service culture and their theories of warfare.*

Examining the development of airpower thought in the Army, Army Air Corps, and Navy during the Interwar Period shows how each organization saw airpower through the lens of its service culture, and acted to expand or limit the role of airpower in accordance with its resistance or desire to change the status quo within the military establishment. In the case of the ground Army, the service culture saw airpower as one among many branches of the service. As such, airpower's purpose within the Army was to support the ground campaign, namely by supporting the efforts of the infantry, which at the time was first among equals in importance in taking and holding ground. The Air Corps' efforts to shift the air arm's focus from support of ground forces to strategic bombing threatened to upset this paradigm and introduce uncertainty, in turn generating stiff resistance from the General Staff to any suggestions of autonomy or independence for the Air Corps. In the lean budgetary years of the Interwar Period, the General Staff

saw any expansion or autonomy of the Air Corps as a threat to funding for the ground Army, further increasing its resistance to growth of the air arm.

For the fledgling Air Corps, the air arm developed over the two-decade period a culture separate and distinct from the ground Army. The Air Corps worshipped at the altar of the airplane, and became increasingly technology-focused while simultaneously developing an overarching strategic concept of long range, strategic bombing of the enemy's vital centers that could achieve war-winning effects far beyond the range of the Army and Navy. This fundamental split in the role of airpower between the ground Army and the Army Air Corps led to the latter's quest for independence, which by the end of the Interwar Period, became a near-irreversible process that culminated with the creation of the United States Air Force in 1947.

In contrast to the Army/Army Air Corps split, and despite initial division over the role of airpower after World War I, the Navy drew on its service culture of adherence to tradition and independence at sea to integrate airpower successfully into the battle fleet. Initially, the old guard of battleship advocates, the "Gun Club," tried to limit the role of airpower to that of an auxiliary to the battle line, acting as little more than aerial spotters for naval gunfire. However, over the following two decades, technological advances in aviation, combined with innovative tactics tested and proved during Fleet Problem exercises, led to aviation slowly supplanting naval gunfire as the primary striking arm of the fleet. Crucially, unlike the Army, naval aviation retained the same purpose as the rest of the Navy—defeat of the enemy fleet through power projection from the sea.

While today's Department of Defense (DoD) speaks about its cyberwarfare capabilities in a unitary manner—that is, projecting the image that all military

cyberwarfare units are functionally interchangeable—Carl Builder's argument still holds that the services will develop distinct versions of cyberwarfighting units according to their institutional biases. In the 2014 *Quadrennial Defense Review,* the DoD treats its cyberwarfare capability as a single force, the "Cyber Mission Force," whose mission is to "support Combatant Commanders as they plan and execute military missions," and "counter cyberattacks against the United States."[1] However, Carl Builder notes that the services' "personality characteristics are strong and persistent," and these characteristics "should be powerful guides to future events," specifically how the services incorporate new technologies and forms of warfare into their existing warfighting paradigms.[2] Just as service culture drove Army, Air Corps, and Navy attitudes toward airpower during the Interwar Period, these cultures, virtually unchanged, drive similar attitudes toward cyberwarfare today.

Today's Army sees cyberwarfare as a supporting branch to the combat arms, producing cyber-based effects for the ground campaign, just as the Interwar Army saw airpower as an auxiliary to the ground campaign. Army General Keith Alexander noted in his "Way Ahead in Cyberspace" that the Army must build a force trained in the "operation and defense of our networks," able to "improve the effectiveness of intelligence operations," and to "provide commanders with assured, secure access to increasingly joint communications."[3]

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[1] *Quadrennial Defense Review 2014*, http://www.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf, 33.

[2] Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis* (Baltimore, MD: Johns Hopkins University Press, 1989), 194.

[3] Keith B. Alexander, "The Army's Way ahead in Cyberspace," *Army Magazine* 63, no. 8 (2013): 25.

The Air Force today mirrors the Air Corps of the Interwar Period, seeing cyberspace as another unique domain of warfare where technologically advanced weapons can achieve strategic effects. Just as the Air Corps embraced the air as a new and unique warfighting domain, so has the Air Force embraced cyberspace as a separate domain, illustrated by the 2008 adoption of the mission statement, "The mission of the United States Air Force is to fly, fight, and win ... in air, space, and cyberspace."[4] Though it has yet to fight a true cyberwar, the Air Force believes that given the right cyberweapons and highly trained cyber operators, it can achieve the same types of strategic effects against an enemy's warmaking ability as it does through airpower.[5]

The Navy treats cyberwarfare today much as it did airpower in the 1920s, as a supporting element to the striking power of the battle fleet. In the most recent Sailing Directions guidance, the Chief of Naval Operations states, "Cyberspace will be operationalized with capabilities that span the electromagnetic spectrum – providing superior awareness and control when and where we need it."[6] For the Navy, the primary function of cyberwarfare is to ensure the fleet has "assured maritime C2 and superior battlespace awareness that allow for sustained, integrated fires across the full range of maritime warfare."[7] Today, cyberwarfare in the Navy ensures the effectiveness of the fleet's power projection capability; in the future, cyberwarfare, like airpower 70 years ago, may become an integral component of the Navy's power projection capability.

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[4] "New Mission Statement," http://www.airforcemag.com/DRArchive/Pages/2008/August%202008/August%2029%202008/NewMissionStatement.aspx.

[5] See, for example, Eric D. Trias and Bryan M. Bell, "Cyber this, Cyber that ... So What?," *Air & Space Power Journal* 24, no. 1 (2010). The specifics of what types of effects the Air Force believes it can achieve through cyberpower and how it intends to achieve them are beyond the scope of this study.

[6] Chief of Naval Operations, "CNO's Sailing Directions," http://www.navy.mil/cno/cno_sailing_direction_final-lowres.pdf, 2.

[7] Kendall Card and Michael Rogers, "The Navy's Newest Warfighting Imperative," *U.S. Naval Institute Proceedings* 138, no. 10 (2012).

Based on the lessons of airpower in the Interwar Period, the Department of Defense should allow the services to continue to pursue cyberwarfare capabilities that are in line with their service cultures and views on warfare. Allowing each service to go its own way will bring a diverse set of cyberpower capabilities to the Joint Force, while minimizing the friction within the services and preventing conflict between cyberpower advocates and their air/land/sea counterparts. Because the Joint Force cannot predict with any certainty what role cyberpower will play in America's next war, allowing the services to pursue different styles of cyberpower increases the probability that at least one of them will have correctly predicted the future role of cyberwarfare.

## Lesson Learned: Personnel

*Lesson Learned: The advancement of cyberpower as a Joint capability requires a cadre of high-ranking converts with sufficient respectability, technological skill, political acumen, and legitimacy to advocate successfully for cyberpower.*

The Interwar Period showed how the Navy and Army Air Corps needed a combination of change agents and heterogeneous engineers to guide the development of airpower within the services. The examples of Admiral William Moffett and General Mason Patrick show how the successful development of airpower required senior officers with credibility among both the service's "old guard" who were committed to the status quo, and younger officers who were to play a critical role in the operationalizing of airpower. The successful development of airpower in the Interwar Period also depended on heterogeneous engineers to take the promise of airpower and turn it into a reality. In the case of the Navy, Admiral Joseph M. Reeves, the commander of Aircraft Squadrons, Battle Fleet, worked closely with Admiral Moffett to operationalize the Navy's first

aircraft carrier, the USS *Langley*, in the process developing tactics, techniques, and procedures still in use today. Reeves' success in the Navy's Fleet Problem exercises gave Moffett much-needed empirical evidence of the value of airpower to the fleet for use in Moffett's battles with the "Gun Club."

In the case of cyberpower today, none of the services possesses standout change agents or heterogeneous engineers. The two military officers most often associated with cyberwarfare, Air Force General Michael Hayden, the Director of the National Security Agency from 2006 to 2009, and Army General Keith Alexander, Hayden's successor and the first (and only) Commander, United States Cyber Command, are both career Intelligence officers, and neither possessed any significant cyberwarfare experience before assuming their posts. Within the services, the commanders of two of the three service cyberwarfare organizations had no cyberwarfare experience or assignments prior to assuming command.[8] In addition, many senior ranking officers in cyberspace billets are either intelligence officers or communications officers who served in their operational assignments before the advent of modern cyberspace operations. Ultimately, the services, in order to exploit fully the potential of cyberpower, will need to put in place a pipeline for senior officers to become credible cyber operators and advocates.

[8] Of the three commanders, one is a career space operations officer, one a career combat engineer, and the third is a specialist in cryptology and information warfare. Though all three are senior officers, Admiral Moffett and General Patrick have shown how beneficial basic qualification training can be to understanding and advocating for new technologies and forms of warfare.

## Lesson Learned: Technology

*Lesson Learned: A fiscally constrained budgetary environment, lack of a specific future enemy, and rapid advancement in cyberwarfare technology will lead to frequent prototyping and low-rate production of cyber capabilities until the next major conflict.*

When determining research, development, and procurement strategies for the Interwar Period, the Army Air Corps and the Navy had to decide what types of strategies they would pursue, and how they would preserve their flexibility in light of rapid technological development in aviation during the period. The Army Air Corps, instead of focusing its procurement strategy on a specific enemy, chose to take advantage of the nation's isolationist policies and focus its efforts on developing a long range defensive capability against enemy bombers and fleets—in effect, choosing a capabilities-based procurement strategy instead of a threat-based strategy. Driven both by the desire to promote rapid advancement of aviation technology and the post-World War I decline in defense spending, the Air Corps focused on small lot buys of aircraft to preserve its Type II flexibility until it could procure a long range bomber able to execute its strategic bombing strategy. In the 1930s, when again faced with constrained budgets in the wake of the Great Depression, the Air Corps fell back on its nascent service culture of high technology and an inherent belief in the power of strategic bombing when making difficult procurement decisions. This resulted in the Air Corps orphaning the development and acquisition of pursuit and attack aircraft in favor of the high technology, long range B-17 bomber.

The Navy, on the other hand, focused its procurement strategy on developing and buying aircraft and aircraft carriers that could defeat the Japanese navy in a western

Pacific naval campaign—choosing a threat-based strategy rather than a capabilities-based strategy. Taking advantage of a native research and manufacturing capability in the late 1920s and close cooperation with commercial aviation companies in the 1930s, the Navy, like the Air Corps, also maintained Type II flexibility in its procurement practices, focusing on small lot buys of aircraft in order to maintain the rapid development pace of carrier aviation-specific technologies, including stronger airframes, folding wings, and more reliable engines. The Navy also made great strides in aircraft carrier development during the Interwar Period, with outside influences, namely the Washington Naval Treaty and budgetary constraints, forcing the service to experiment with different sizes of carriers in order to arrive at the best combination of size and flexibility.

Today, both the Air Force and the Navy use the Air Corps' capabilities-based strategy model for building their research, development, and procurement programs. In a 2012 Air Force Space Command Industry Day presentation, a senior representative of 24th Air Force, the Air Force's lead cyberwarfighting organization, described how the Air Force uses prioritized capabilities within the Cyberspace Superiority Core Function to develop and deliver offensive and defensive cyberwarfare capabilities to the Combatant Commands.[9] *Navy Cyber Power 2020*, the Navy's latest cyberspace strategy document, also focuses primarily on what cyberwarfare capabilities the U.S. Fleet Cyber Command will provide to Combatant Commands, with only brief references to the danger of "state and non-state adversaries."[10]

[9] David Barnhart, "AF Strategy that Drives Our Cyber Acquisition," http://www.24af.af.mil/shared/media/document/AFD-120822-068.pdf.

[10] *Navy Cyber Power 2020*, November 2012, www.public.navy.mil/fcc-c10f/Strategies/Navy_Cyber_Power_2020.pdf, 2.

Like the Air Corps of the late 1920s, the cyberwarfare platforms available to today's Air Force are technologically insufficient to meet its vision for fighting effectively in cyberspace, with significant gaps in indications and warning, attribution and characterization, correlation and visualization, and integrated response capabilities.[11] In the future, the Air Force should mirror the Air Corps' efforts to build a long range strategic bomber in the 1930s by collaborating with industry to press for rapid advancement of cyberwarfare technology while deferring large-scale procurement commitments until the technology can fulfill adequately the Air Force's requirement. The Navy is in a similar situation, noting in its strategy document, "Industry drives the accelerating pace of change in cyberspace, not government," just as commercial aviation drove technological progress in the 1930s.[12] Thus, today's Navy seeks to emulate the Interwar Navy by leveraging industry, academia, and allies to update cyberspace systems based on "unique Navy capabilities or requirements," as rapidly as possible.[13] This pursuit of Type II flexibility by both services makes sense given the rapid technological progress in cyberspace and today's fiscally constrained budgetary environment.

Just as both services suffered from, and ultimately learned from, high profile aviation disasters during the Interwar Years, namely the Air Mail Fiasco for the Air Corps and multiple airship disasters for the Navy, the Department of Defense suffered its first high profile cyber disaster in 2008. That year, the Department discovered a flash drive infected with a piece of malicious code, named Agent.btz, had been inserted into a military laptop, and from there had entered a network run by United States Central Command. As Deputy Secretary of Defense William Lynn wrote in 2010, the Agent.btz

[11] Barnhart, "AF Strategy."
[12] *Navy Cyber Power 2020*, 2.
[13] Ibid., 7.

attack revealed a glaring hole in the network's defenses, and was, "the most significant breach of U.S. military computers ever, and it served as an important wake-up call."[14] This compromise of USCENTCOM's network led to a new generation of cyber defensive tools and employment tactics, and drove the Department to consolidate its Joint cyberwarfare organizations, combining and expanding two cyber-based Joint Task Forces into the United States Cyber Command, a subunified command of United States Strategic Command.[15] The Department, like the Interwar Air Corps and Navy before it, successfully recovered from the disaster and eventually placed the Joint force on a sound footing for future cyberwarfare actions.

## Conclusion

The Interwar Period, 1919-1939, saw rapid expansion and development of warfare in the third dimension, which Wilbur and Orville Wright opened to manned flight less than two decades before. The Interwar ground Army chose to see airpower as simply another tactical weapon, artillery from the air, and resisted airpower advocates' efforts to expand airpower's reach beyond the infantry battle. The Army Air Corps, in contrast, saw airpower as a fundamentally different form of warfare, and believed that long range strategic bombing could create decisive effects on its own, far beyond the reach of the infantry and naval fleets. The Navy took a middle ground, moving faster than the ground Army to acknowledge the increased range and striking power of airpower over traditional land and sea power, yet taking an evolutionary approach in integrating airpower into the

[14] William J. Lynn III, "Defending a New Domain: The Pentagon's Cyberstrategy," http://www.foreignaffairs.com/articles/66552/william-j-lynn-iii/defending-a-new-domain.

[15] Ellen Nakashima, "Cyber-Intruder Sparks Massive Federal Response—and Debate over Dealing with Threats," December 8, 2011, http://www.washingtonpost.com/national/national-security/cyber-intruder-sparks-response-debate/2011/12/06/gIQAxLuFgO_story.html.

naval fleet vice the Air Corps' revolutionary drive for independence. Rapid technological advancement in aviation during the Interwar Period resulted in much uncertainty, which the Air Corps and Navy handled in similar, yet distinct ways—the Air Corps by pursuing a capabilities-based strategy of rapid prototyping and focus on building a long range strategic bomber, and the Navy by pursuing a threat-based strategy of rapid prototyping and focus on naval aviation-specific requirements.

This examination of the progress of airpower during the Interwar Period yields several lessons for today's similar progress of cyberpower. In the area of personnel, the advancement of cyberpower as a Joint capability requires a cadre of high-ranking converts with sufficient respectability, technical skill, political acumen, and legitimacy to advocate successfully for cyberpower. Though part of a Joint team, the military services will tend to employ cyberpower in accordance with service culture and their theories of warfare. Finally, when deciding on research, development, and procurement strategies in a fiscally constrained budgetary environment, the lack of a specific future enemy and rapid advancement in cyberwarfare technology will lead the services to pursue frequent prototyping and low production of cyber capabilities until the next major conflict. The last two decades saw the opening of a new and fundamentally different domain to warfare, and the United States military services are still struggling with the associated uncertainty of this new domain and its rapid technological progress. Fortunately, we have been in this situation before, and a study of the services' successes and failures during the Interwar Period is of great use in addressing the uncertainties of cyberpower today.

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# VITA

Most recently, Lt Col Schrader served as the Commander of the 7th Expeditionary Command and Control Squadron, stationed at Al Udeid Air Base, Qatar. As the commander of the Air Force's only E-8C Joint Surveillance Target Attack Radar System (JSTARS) combat squadron, he was responsible for producing combat capability in Afghanistan and the Arabian Gulf as USCENTCOM's lead ground moving target indicator producer. He has also served as Deputy Chief for Strategic Studies for Headquarters, Air Force Space Command, and as Chief of Safety for the 461st Air Control Wing. Lt Col Schrader commissioned through ROTC (Distinguished Graduate) at the University of Washington in 1996. He is a master electronic warfare officer with over 3,000 flying hours, including over 1,000 combat hours, in the AC-130U, RC-135V/W, and E-8C, and has flown combat missions in Operations JOINT GUARD, JOINT FORGE, ALLIED FORCE, SOUTHERN WATCH, IRAQI FREEDOM, and ENDURING FREEDOM. Lt Col Schrader is a graduate of the Air Force Institute of Technology with a Master's of Science in Computer Engineering, and of the School of Advanced Air and Space Studies.